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ABSTRACT

This manual provides information needed to meet the standards for pesticide applicator certification. It presents pest control guidelines for those organisms of public health significance. Fact sheets with line drawings discuss pests such as cockroaches, bedbugs, lice, ants, beetles, bats, birds, and rodents. (CS)

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COOPERATIVE EXTENSION SERVICE

University of New Hampshire

PUBLIC HEALTH PEST CONTROL

CATEGORY MANUAL

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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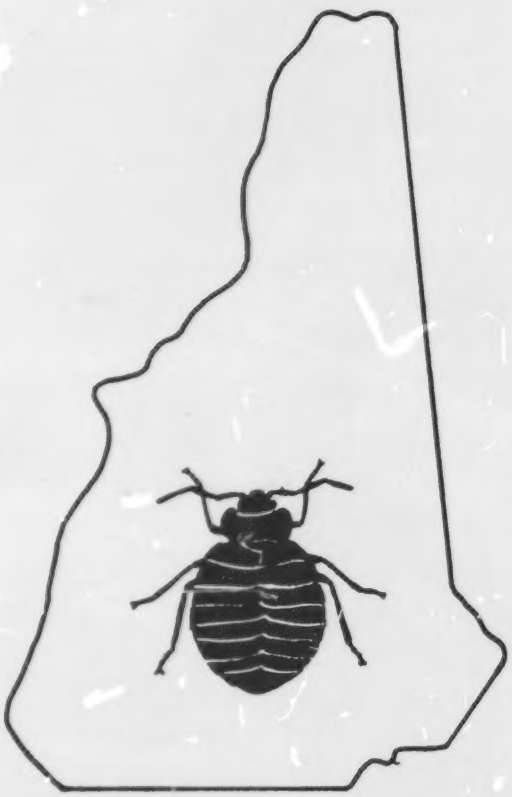

SE 024 021

COMMERCIAL PESTICIDE APPLICATOR TRAINING

This training manual is intended to provide you with the information you will need to meet the standards of the E.P.A. for pesticide applicator certification, and prepare you to take an examination given by the State of New Hampshire Department of Agriculture based on this manual. It is not intended to provide you with all the information you need for effective pest control. Additional information in the form of publications and short courses can be obtained from the Cooperative Extension Service.

This manual has been prepared by:

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in cooperation with:

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Institute of Natural Environmental Resources, Univ. of New Hampshire.
The Environmental Protection Agency.
U.S. Dept. of Health, Education, and Welfare, Public Health Service, Communicable Disease Center, Atlanta, Georgia.

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ORGANISMS OF PUBLIC HEALTH SIGNIFICANCE

COMMON NAME	PUBLIC HEALTH SIGNIFICANCE
Ant	bite, sting; infest stored food; damage wood
Bat	associated with rabies, histoplasmosis and many other diseases
Bed Bug	cause dermatitis; not known to transmit disease
Bee, Hornet, etc.	bite and sting; infest stored food; damage wood
Beetle	infest stored food; infest human intestine; cause dermatitis
Bird	associated with histoplasmosis, ornithosis and many other diseases
Book Louse, Psocid	infest stored food
Caterpillar	sting; infest intestinal tract
Centipede	venomous bite; infest nasal, intestinal, and urinary tracts
Chewing Louse	infest domestic birds and mammals
Cockroach	transmit enteric diseases
Collembola	infest stored food; used as indicator organisms for pesticide studies
Copepod	involved in transmission of broad fish tapeworm and guinea worm
Daddylongleg Spider	infest houses; harmless
Earwig	household pests
Flea	cause dermatitis; transmit plague, murine typhus, tapeworms
Fly	some bite; larvae infest human flesh; transmit typhoid, paratyphoid, cholera, bacillary dysentery, infantiel diarrhea, amebic dysentery, giardiasis, helminths, trachoma, conjunctivitis, yaws, anthrax, tularemia, African sleeping sickness, leishmaniasis, onchocerciasis, loiasis, bartonellosis, sandfly fever
Ked or Louse Fly	occasionally bite man
Kissing Bug	transmit Chagas disease
Lagomorph	transmit tularemia and many other diseases
Lobster, Crab, etc.	involved in transmission of oriental lung fluke
Millipede	exude vesicating venom; infest digestive and urinary tract; intermediate host of tapeworms
Mite	cause dermatitis; infest human intestine; transmit scrub typhus, rickettsialpox, epidemic hemorrhagic fever

COMMON NAME	PUBLIC HEALTH SIGNIFICANCE
Mosquito	transmit malaria, encephalitis, yellow fever, dengue, filariasis
Moth or Butterfly	infest stored food; infest human intestine; some have stinging hairs
Pseudoscorpion	infest houses; harmless
Rodent	transmit leptospirosis, lymphocytic choriomeningitis, etc.
Scorpion	sting
Sea Spider	appearance causes fear; harmless
Silverfish, Firebrat	infest stored food; transmit enteric diseases
Snake	venomous bite; secondary infection of bites
Sowbug, Pillbug	household pests; harmless
Spider	venomous bite
Sucking Louse	cause dermatitis; transmit epidemic typhus, trench fever, relapsing fever
Sun Spider	non-venomous bite
Termite	destroy wood; housing deterioration
Thrips	bite man occasionally
Tick	cause dermatitis, tick paralysis; transmit spotted fever, relapsing fever, tularemia, Colorado tick fever, Russian spring-summer encephalitis
Whip Scorpion	appearance causes fear; harmless

COCKROACHES

There are several species of cockroaches in U. S. but only four of them are found throughout the United States. They vary in appearance and habits, but in general, are all flat, brownish or dark colored, and fast running. All roaches seek cover in the daytime or when disturbed at night. They may be carried into buildings in boxes, beverage cases, and shopping bags from the grocery store. They migrate from apartment to apartment along water pipes, cracks in walls, wall voids, steam pipes and sewer lines. They feed on starchy materials such as cereals. sugary substances, dried fruits, and meat products. Roaches frequent cheese, beer, leather, hair, wallpaper, and dead animals.

Cockroaches have three stages of development: Egg, nymph, and adult. Eggs are deposited within an egg capsule called an ootheca. This ootheca contains up to 16 eggs. From this egg capsule hatch small white nymphs which will darken to a brown color as the exoskeleton begins to dry and harden. The nymphs molt four times before becoming adults. Depending upon the species involved, development from egg to adult takes from 6 to 7 months.

According to Arnold Mallis:

> *"Cockroaches have often been held suspect as disease carriers, and they are believed to be as suitable for the conveyance of common germs as is the house fly."*

These diseases and organisms include cholera vibrios, coliform bacilli, Gastro-enteritis, and Salmonella.

AMERICAN COCKROACH - Periplaneta americana (L.)

This is the largest of the usual house-infesting roaches. When fully grown they are approximately 1½" in length with fully developed wings. The wings are reddish brown in color with light markings on the thorax.

The American roach is commonly found in basements of homes around the heating pipes and sewage systems, in restaurants, grocery stores, bakeries and food preparation areas.

GERMAN COCKROACH - Blattella germanica (L.)

This roach is smaller than the American roach. When fully grown it is about ½" in length. Both male and female are brown in color and have two dark streaks on the thorax. The male is a lighter brown color than the female. The female produces 30 to 40 eggs per egg capsule.

The German cockroach is the most common roach found in New Hampshire. It is found in restaurants, grocery stores, food preparation areas and in homes.

BROWN-BANDED COCKROACH - Supella supellectilium (Serville)

The name brown-banded refers mainly to the immature stage of this roach. Even though the band is present in both adult and immature stages, it is more distinct in the nymphal stage.

This cockroach favors kitchens (cupboards, pantries) but can be found in any room of the house. The adult is an active flier which accounts for its ability to spread easily.

ORIENTAL COCKROACH - Blatta orientalis (L.)

As an adult, the Oriental cockroach attains a length of one inch. It is shiny black in color. Wings of this species are very small in females and only cover 3/4 of the abdomen in males. This roach favors damp areas in basements and often enters homes through sewer openings. During the warm summer months, this roach may live outdoors and re-enter into the home as cooler weather returns in the fall.

COCKROACHES: PICTORIAL KEY TO SOME COMMON SPECIES

Harry D. Pratt

SMALL, ABOUT 5/8" OR SHORTER

PRONOTUM WITH 2 LONGITUDINAL BLACK BARS

GERMAN COCKROACH
(Blattella germanica)

PRONOTUM WITHOUT LONGITUDINAL BLACK BARS

WINGS COVERING ABOUT HALF OF ABDOMEN PRONOTUM ABOUT 1/4 INCH WIDE

WOOD ROACH
(Parcoblatta spp.)

WINGS COVERING NEARLY ALL OF ABDOMEN OR EXTENDING BEYOND. PRONOTUM NARROWER

FEMALE

MALE

BROWN-BANDED COCKROACH
(Supella supellectilium)

MEDIUM TO LARGE, LONGER THAN 5/8 INCH

WINGS ABSENT, OR SHORTER THAN ABDOMEN

WINGS ABSENT

FEMALE

WINGS SHORTER THAN ABDOMEN

MALE

ORIENTAL COCKROACH
(Blatta orientalis)

WINGS COVERING ABDOMEN, OFTEN EXTENDING BEYOND

PRONOTUM MORE THAN 1/8 INCH WIDE

PRONOTUM ABOUT 1/4 INCH WIDE WITH PALE BORDER

WOOD ROACH
(Parcoblatta spp.)

FRONT WING WITHOUT PALE STREAK. PRONOTUM SOLID COLOR, OR WITH PALE DESIGN ONLY MODERATELY CONSPICUOUS

PRONOTUM SOLID DARK COLOR. GENERAL COLOR VERY DARK BROWN TO BLACK

SMOKY BROWN COCKROACH
(Periplaneta fuliginosa)

PRONOTUM USUALLY WITH SOME PALE AREA. GENERAL COLOR SELDOM DARKER THAN REDDISH CHESTNUT

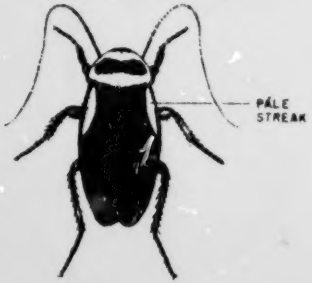
LAST SEGMENT OF CERCUS NOT TWICE AS LONG AS WIDE

BROWN COCKROACH
(Periplaneta brunnea)

LAST SEGMENT OF CERCUS TWICE AS LONG AS WIDE

AMERICAN COCKROACH
(Periplaneta americana)

FRONT WING WITH OUTER PALE STREAK AT BASE. PRONOTUM STRIKINGLY MARKED



AUSTRALIAN COCKROACH
(Periplaneta australasiae)

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Communicable Disease Center
Training Branch
Atlanta, Georgia – 1953

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COCKROACHES: COMPARISON OF BIOLOGICAL FACTORS

Biological Characteristic	German Cockroach	American Cockroach	Oriental Cockroach	Brown-banded Cockroach
Average number of eggs per capsule	36	16	16	18
Incubation period for eggs in days	28.4 (average)	38-49	42-81	50-70
Length of time the female carries egg capsule	Entire incubation period except for last few hours	About a day after it is formed	About 30 hours	24 to 26 hours
Average number of young that emerge from an egg capsule	29.9	13.3	14.4	13.2
Where egg capsules are deposited	In cockroaches' hiding place	In cracks and crevices	Warm, sheltered spots	Attached to objects
Average number of generations per year	3	1 at most	1 at most	1 to 2
Flying ability	Does not fly	Males fly; females glide	Does not fly	Active flier
Where found	Homes, restaurants, ships	Homes, cellars, ships, restaurants	Sewer pipes, sidewalks, heat tunnels, damp cellars, buildings, bathrooms, laundries	Closets, kitchens, furniture, behind pictures

COCKROACHES: KEY TO EGG CASES
OF COMMON DOMESTIC SPECIES

less than ¼" long
subsegments apparent

more than ¼" long
subsegments inapparent

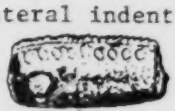
with about 16
subsegments; length
more than twice width

Blatella germanica
GERMAN COCKROACH

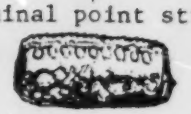
with about 8
subsegments; length
less than twice width

Supella supellectilium
BROWN-BANDED COCKROACH

with lateral indentations

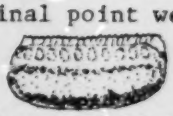


terminal point strong



Periplaneta orunnea
BROWN COCKROACH

terminal point weak



Periplaneta fuliginosa
SMOKY-BROWN COCKRCACH

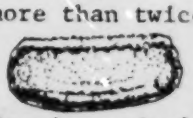
without lateral indentations

not symmetrical

Blatta orientalis
ORIENTAL COCKROACH

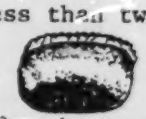
symmetrical

length more than twice width



Periplaneta australasiae
AUSTRALIAN COCKROACH

length less than twice width



Peripianeta americana
AMERICAN COCKROACH

DOMESTIC RODENTS AND COCKROACHES: PICTORIAL KEY TO DROPPINGS

Harold George Scott and Margery R. Borom

length over 1/3-inch*

rectangular, blunt

Rattus norvegicus
NORWAY RAT

length under 1/4-inch*

elongate, pointed

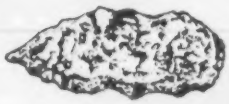
Rattus rattus
ROOF RAT

elongate, pointed

without ridges
length about 1/4-inch

Mus musculus
HOUSE MOUSE

with ridges
length about 1/16-inch



Blatella germanica
GERMAN COCKROACH

rectangular, blunt
with ridges

ovoid, pointed
with ridges

length about 1/8-inch

Periplaneta americana
AMERICAN COCKROACH

length about 1/16-inch

Blatta orientalis — ORIENTAL COCKROACH or
Periplaneta fuliginosa — SMOKY BROWN COCKROACH

length about 1/8-inch

Periplaneta australasiae
AUSTRALIAN COCKROACH

length about 1/16-inch

Periplaneta brunnea
BROWN COCKROACH

length about 1/32-inch

Supella supellectilium
BROWN-BANDED COCKROACH

*All characteristics for average, dry, adult droppings. Study groups, not individual droppings.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1964

BROWN DOG TICK

Family: Ixodidae

The Brown Dog Tick (Rhipicephalus sangvineus (Latr.)) is one of the most widely distributed ticks in the world. It can be found on a wide range of hosts, but by far the most common host is the domestic dog. There are a few records of this tick on man and the domestic cat, but they are not very common.

Ticks go through four stages of development: Egg, larva, nymph and adult. Upon hatching from the eggs, the larvae wait for a dog to attach to. They are able to go without feedings for up to eight months before attaching themselves to the dog. Once they have attached themselves to the dog, they feed for about three days and then drop off. One week after that blood meal, they molt and the nymph emerges. Again, the nymph awaits the arrival of another dog to feed upon. Feeding in the nymphal stage lasts up to four days and the nymph then drops off and molts into the adult stage. Nymph and larval stages can be found attached to the hairs along the backs of their hosts. Before mating, a blood meal is required. The adult can survive for up to 1½ years before its next blood meal. Adults can be found attached to the ears or between the toes of its host. After feeding, the engorged female drops from the dog and begins to lay eggs in about three days. She will lay up to 5,000 eggs. (Egg laying will be done between boards, under carpeting, under plaster and along cracks and crevices in the home.)

Dogs usually pick up ticks from infested residences and boarding kennels. They do not become infested by contact with other dogs

The Brown Dog Tick cannot overwinter outdoors in New Hampshire and must find overwintering quarters in heated buildings.

AMERICAN DOG TICK

The American Dog Tick (Dermacentor variabilis) is found primarily outdoors in New Hampshire. The preferred host is the domestic dog, but the adult American Dog Tick has been readily found on other large mammals such as deer, raccoon, squirrel and man. The immature stages (larvae and nymphs) feed on small rodents including moles, shrew and rabbits.

The entire life cycle of the American Dog Tick takes from 4 months to one year. There is one generation per year in New Hampshire. The American Dog Tick can overwinter outdoors in New Hampshire.

DOG TICK CONTROL

American dog tick control is done outside the home, for this tick is unable to complete its life cycle within the home. The brown dog tick is a nuisance in the home and control measures should be applied in the home.

A residual spray should be applied to infested areas. Treatment of the dog alone will not give adequate control. A residual spray is necessary in order to ensure control of the emerging larvae from egg in the area. Residual sprays include:

propoxur	(brown dog ticks only)	carbaryl	stirifos
ronnel	chlorpyrifos	diazinon	malathion

For treatment of the dog:
Washes of coumaphos, malathion or lindane. Dusts of lindane, carbaryl, coumaphos, trichlorfon or malathion. These treatments should be done by a veterinarian.

BEDBUGS

Most democratic is the bedbug chappie
Who prefers red blood to blue
And nothing makes him quite so happy
As sharing - your blood with you!
(From Mallis)

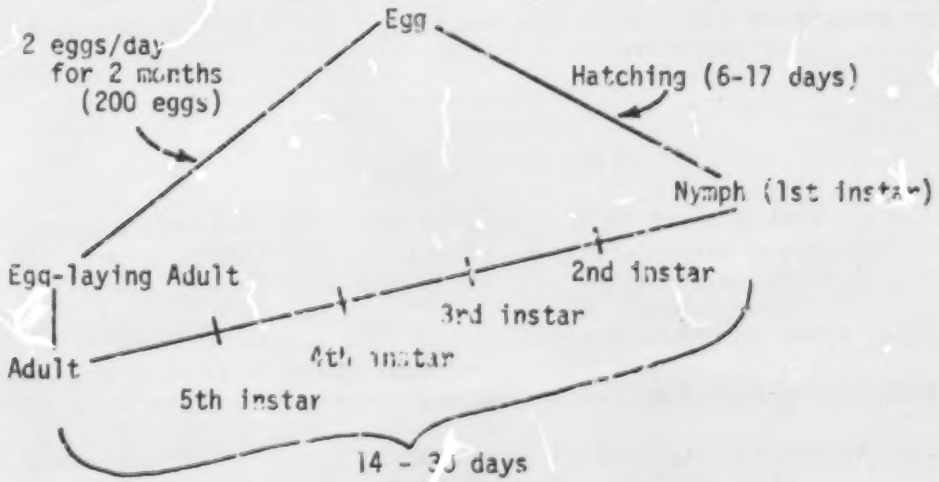
Bedbugs are not host specific, in fact, they can be found where ever man and his domestic animals dwell. According to Arnold Mallis "although this democratic creature draws no line between the impoverished and the wealthy, its presence is more evident in the poorer quarters since conditions for its survival are more favorable there. The 'bedbug house' may be recognized by the distinctive bedbug odor, by the bloodstains of squashed bugs that are present on the wall, as well as by the bedbug's excretory spots."

Bedbugs move from one house to another mainly by stowing away in furniture and bedding. They have also been known to migrate in books, second-hand furniture, timber from old homes and laundry.

When bedbugs reach their destination, they establish themselves in cracks and crevices in and around the bedding area of their host. In the home, they will hide along mattress seams, in bedspring coils, wooden bedsteads, upholstered furniture, behind picture frames, under wallpaper, between floor boards, etc.

The sole food of the bedbug is blood of warm-blooded animals (man, cats, dogs, bats, birds, etc.). After feeding, the bedbug removes its piercing-sucking mouthpart, pauses momentarily, then finds a place to hide for six to ten days. (If this is during the nymphal stage, the nymph sheds its old skin during this period.)

The life cycle of the bedbug is as follows:



Entire cycle - 4 to 9 weeks

Control: Bedbugs are easily controlled with sprays of 1% malathion, 1% Ronnel, .5% DDVP or 0.5% synergized pyrethrins. These sprays can be used on or near beds and furniture. Do not treat the bedding. If the mattress is to be treated, treat only the seams, folds, buttons or tears. Do not use the mattress until the material has dried and the mattress has been covered.

Residuals sprays can also be used when not applied to the beds. These materials include .5% diazinon, 2% malathion, or 1% Ronnel.

COOPERATIVE EXTENSION SERVICE
University of New Hampshire
Department of Entomology and
New Hampshire Department of Agriculture cooperating

BUG FACTS

HUMAN LICE

Dr. Robert L. Blickle
Professor of Entomology

Arthur H. Mason
State Entomologist

Figure 1
Pediculus humanus capitis head louse

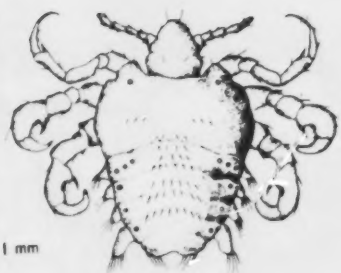


Figure 2
Pthirus pubis crab louse

Entomologists classify lice as to (1) the order Mallophaga, chewing lice or, as the name suggests, wool-eaters. These live on birds and mammals except man and pigs. They feed primarily on feathers, skin products and hair and do not suck blood. Even though domestic animals have them, they do not infest humans; (2) the order Anoplura, sucking lice, is so named because they are flattened dorso-ventrally and have no apparent or noticeable pleura or sides to the body.

The Anoplura, sucking lice, live on mammals; marine, domestic and primates. Even though the two orders superficially resemble each other, they are radically different in feeding habits. The sucking lice feed on blood and have protrusible mouthparts. They are also less active than chewing lice and their legs are adapted to cling to hairs. In general, these lice have pointed heads (triangular in shape) while the chewing lice have broad, more rectangular or semi-circular-shaped heads.

Three Lice Infest Humans

Only three of the more than 200 known sucking lice infest humans. These three species are commonly known as the body louse, the head louse and the pubic louse.

The first two are very closely related and, although they may be identified by differences in body structure, it is easier to identify the species by their nits (eggs) and the place they are found on the human body.

Lice have been known for centuries. Human lice were found on embalmed mummies in Peru.

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The life cycle of human lice varies as to the species concerned. The ***Human Body Louse*** or cooties, as the name implies, feeds on the body. It lives in the clothing and lays its eggs on the seams and fibers of clothing, especially the underclothing. It lives in clothing where it is in close contact with the body and visits the body to feed. Although there are exceptions, if a body louse decides to move around it may be found at various places on the body although normally near areas where the clothing is tight.

This is the louse that has been implicated in the spread of disease throughout the world, not in New Hampshire. It is the louse that is a pest during wartime or when people are crowded together and clothing may not be changed too frequently. A condition called "Vagabond's disease" is due to heavy and prolonged infestations of lice. The skin becomes pigmented and thickened. The number of lice on a person may be a dozen or so, although heavier infestations have been recorded. This louse, although found in New Hampshire is not considered to be present in large numbers.

These lice may spread quite easily in crowded and unsanitary conditions during close personal contact. They may also be spread in sanitary and uncrowded conditions by close personal contact or contact with infested clothing. Usually, if one changes clothes frequently, those lice in the unworn clothing die of starvation or are destroyed by washing and cleaning.

The Head Louse: Although head lice are not considered as disease vectors, they are pests and undesirable. They occur on the head and the nits or eggs are cemented to the hairs, usually behind the ears. These lice may also be found in the headgear or possibly on other parts of the body.

An infestation of head lice is usually based on the finding of nits on the hairs. This may be difficult unless done by one familiar with the nits and the object is examined under a microscope. Hair casts, skin from the hair follicle, may be confused with nits unless examined carefully. Empty nits are not easily removed from a hair and there have been rare instances where wigs made of sterilized hair have been found to have louse eggs attached.

These insects spend their entire life cycle on the head so one would find adults, immatures and nits on the head or in the hair. They may be spread by the use of personal items such as hats, brushes and combs; also one can become infested from the backs of upholstered furniture or bedding if used after lice have wandered from an infested head to these objects. An infestation might be acquired by anyone.

These lice, like all human lice, cannot live away from the body for a period longer than 48 to 72 hours. They acquire warmth and a food source, otherwise they die of starvation or as a result of low temperatures.

The Pubic Louse: This insect is not a disease vector. It causes intense itching and secondary infections may result from scratching. Here the nits are attached to hairs and the entire life cycle is spent on the host. This insect usually dies in about 24 hours when separated from its host. Although close sexual contact is the usual means of spread, it has been recorded as being transmitted from infested bedding and other infested articles. They can be spread from person to person under crowded living conditions.

Treatment: Head and pubic (crab) lice infest the hair. The pubic louse usually is found in coarse hair on the body. To eliminate these lice and their nits, it is necessary to treat infested areas. Many preparations are available for the control of lice.

Those containing hydrocarbons, such as DDT or Lindane, are available only by prescription. Others containing pyrethrins, copper oleate or thiocyanates may be purchased without a prescription (follow the label directions).

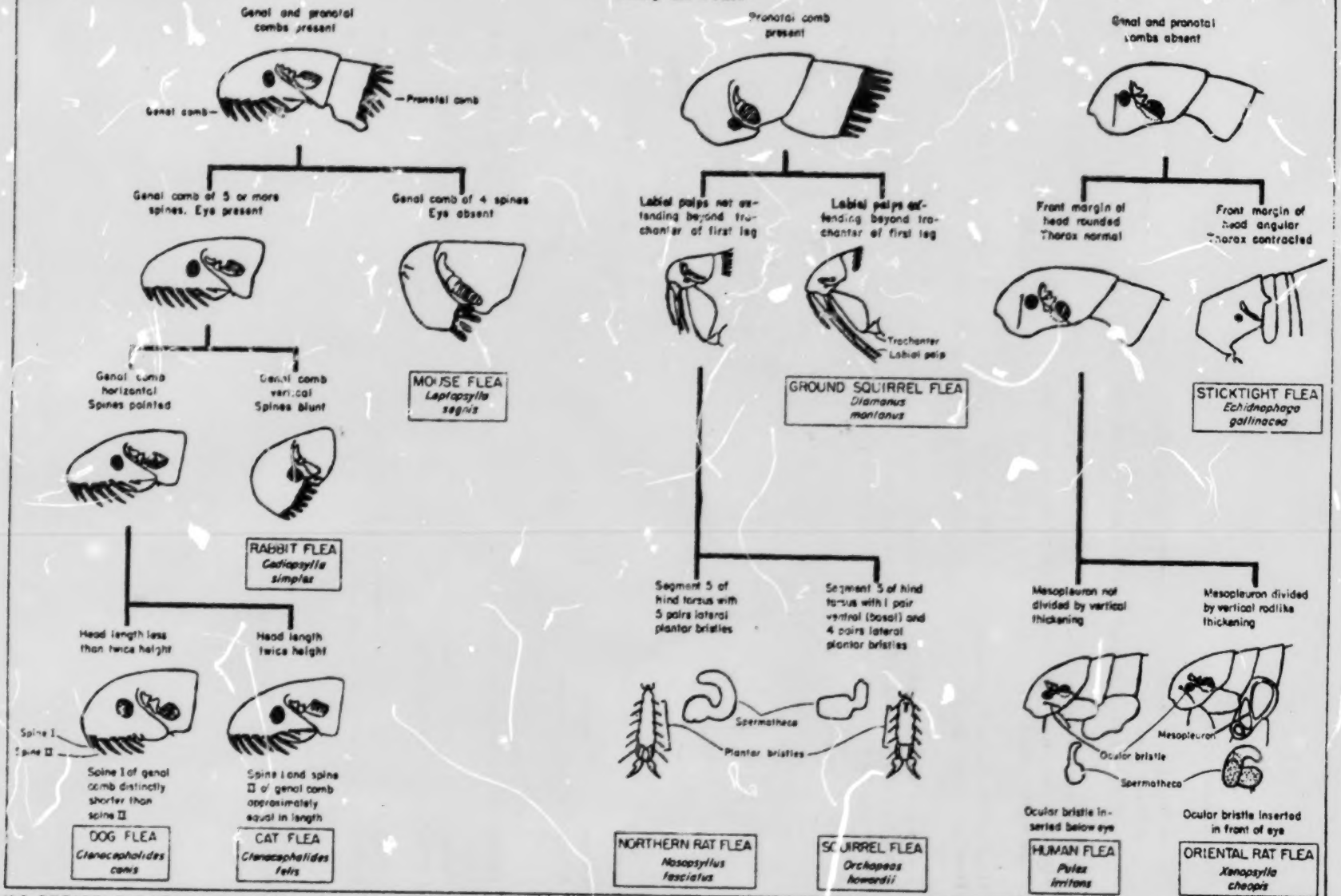
Washing the hair is not an adequate treatment in eliminating lice since the temperature of the water is not sufficient to kill all the stages. Body lice that infest clothing require a minimum temperature of 51°C. (123.8°F.) for five minutes to kill the adults and 52°C. (125.0 F.) for 10 minutes to kill the nits. Ordinary laundering in hot water or dry cleaning is usually enough to control or eliminate lice or nits on clothing.

Louse powders are recommended by the U.S. Public Health Service and W H O (World Health Organization). They may not be available and, in some cases, a dusting of the hair or clothes may not be accepable since the powder preparation should remain on the body or clothes for several days to be effective. One may prefer shampoos or lotions.

Do not over-react and apply excessive amounts of chemicals. Be certain to follow the directions on the label.

FLEAS: PICTORIAL KEY TO SOME COMMON SPECIES IN THE UNITED STATES

Harry D. Pratt


Genal and pronotal combs present
Genal comb
Pronotal comb
Genal comb of 5 or more spines. Eye present
Genal comb of 4 spines Eye absent
Genal comb horizontal Spines pointed
Genal comb vertical Spines blunt
MOUSE FLEA Leptopsylla segnis
RABBIT FLEA Cediopsylla simplex
Head length less than twice height
Head length twice height
Spine I
Spine II
Spine I of genal comb distinctly shorter than spine II
Spine I and spine II of genal comb approximately equal in length
DOG FLEA Ctenocephalides canis
CAT FLEA Ctenocephalides felis
Pronotal comb present
Labial palps not extending beyond trochanter of first leg
Labial palps extending beyond trochanter of first leg
Trochanter
Labial palp
GROUND SQUIRREL FLEA Diamanus montanus
Segment 5 of hind tarsus with 5 pairs lateral plantar bristles
Segment 5 of hind tarsus with 1 pair ventral (basal) and 4 pairs lateral plantar bristles
Spermatheca
Plantar bristles
NORTHERN RAT FLEA Nosopsyllus fasciatus
SQUIRREL FLEA Orchopeas howardii
Genal and pronotal combs absent
Front margin of head rounded Thorax normal
Front margin of head angular Thorax contracted
STICKTIGHT FLEA Echidnophaga gallinacea
Mesopleuron not divided by vertical thickening
Mesopleuron divided by vertical rodlike thickening
Mesopleuron
Ocular bristle
Spermatheca
Ocular bristle inserted below eye
Ocular bristle inserted in front of eye
HUMAN FLEA Pulex irritans
ORIENTAL RAT FLEA Xenopsylla cheopis

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1956

ANTS: KEY TO SOME COMMON SPECIES

Harold George Scott

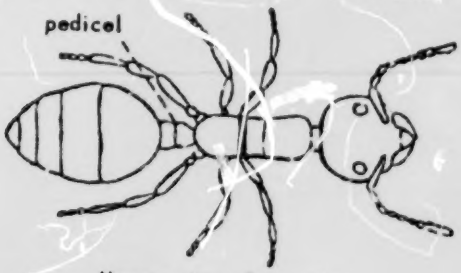
1. Pedicel ("waist") 1-segmented 2
   Pedicel 2-segmented 4

2. Petiole (scale on pedicel) poorly developed, hidden beneath abdomen (*Tapinoma sessile*) ..... ODOROUS HOUSE ANT
   Petiole well-developed, erect, not hidden beneath abdomen 3

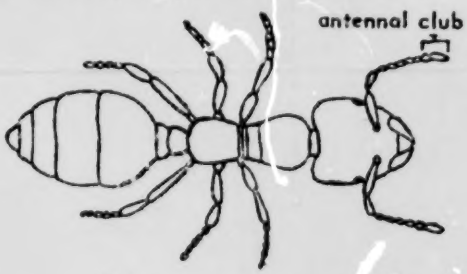
3. Tip of abdomen without circlet of hairs (*Iridomyrmex humilis*) ..... ARGENTINE ANT
   Tip of abdomen with circlet of hairs (*Camponotus herculeanus pennsylvanicus*) ..... BLACK CARPENTER ANT

4. Head and thorax with numerous spines (*Atta texana*) ..... TEXAS LEAF-CUTTING ANT
   Head and thorax spineless or with 1 pair of spines on the posterior thorax 5

5. Thorax and head covered with "fingerprints"; posterior thorax with single pairs of spines (*Tetramorium caespitum*) ..... PAVEMENT ANT
   Thorax and head without "fingerprints"; posterior thorax without spines 6



Monomorium pharaonis



Solenopsis molesta

6. Antennal club 2-segmented 8
   Antennal club 3-segmented 7

7. Shiny-black (*Monomorium minimum*) ..... LITTLE BLACK ANT
   Yellowish-red (*Monomorium pharaonis*) ..... PHARAOH ANT

8. House infesting ants (*Solenopsis molesta*) ..... THIEF ANT
   Outdoor mound-building ants 9

9. Mandibles strongly incurved (*Solenopsis geminata*) ..... TROPICAL FIRE ANT
   Mandibles not strongly incurved 10

10. Dorsal surface of head with large coarse, scattered punctures (*Solenopsis saevissima* var. *richteri*) ..... IMPORTED FIRE ANT
    Dorsal surface of head without punctures (*Solenopsis xyloni*) ..... SOUTHERN FIRE ANT

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1963

BEETLES: PICTORIAL KEY TO SOME SPECIES COMMONLY ASSOCIATED WITH STORED FOODS

Harry D. Pratt

PRONOTUM WITH 4 TEETH ON EACH SIDE
BEAK ABSENT; SPECIES ABOUT 1/8 INCH LONG

SAW-TOOTHED GRAIN BEETLE
Oryzaephilus surinamensis

PRONOTUM WITHOUT TEETH ON EACH SIDE
BEAK ABSENT

PRONOTUM WITHOUT TEETH ON EACH SIDE
BEAK PRESENT; SPECIES ABOUT 1/8 INCH LONG

SMALL BROWNISH SPECIES
LESS THAN 1/4 INCH LONG

LARGER BLACKISH SPECIES
1/4 TO 3/4 INCH LONG

EACH FORE WING WITH 2 PALE SPOTS
PRONOTUM WITH ROUND PUNCTURES

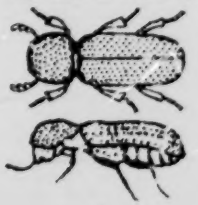
RICE WEEVIL
Sitophilus oryzae

EACH FORE WING DARK
PRONOTUM WITH ELONGATE PUNCTURES

GRANARY WEEVIL
Sitophilus granarius

HEAD VISIBLE FROM ABOVE
1/8 INCH LONG OR MORE

HEAD HIDDEN UNDER PRONOTUM
LESS THAN 1/8 INCH LONG



CONFUSED AND RED FLOUR BEETLES
Tribolium confusum AND *castaneum*

FLATTENED BEETLES
1/4 TO 1/2 INCH LONG
PRONOTUM SEPARATED BY STRONG CONSTRICTION FROM BASES OF WINGS

CADELLE
Tenebroides mauritanicus

CONVEX BEETLES
1/2 INCH LONG OR MORE
PRONOTUM NOT SO STRONGLY SEPARATED FROM BASES OF WINGS

YELLOW MEAL WORM
Tenebrio molitor

FORE WING WITH ROUGHENED SURFACE

LESSER GRAIN BORER
Rhyzopertha dominica

FORE WING WITH LINES

DRUG STORE BEETLE
Stegobium paniceum

FORE WING SMOOTH

CIGARETTE BEETLE
Lasioderma serricorne

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1958

STINGING HYMENOPTERA:
PICTORIAL KEY TO SOME COMMON UNITED STATES FAMILIES

Harold George Scott and Chester J. Stojanovich

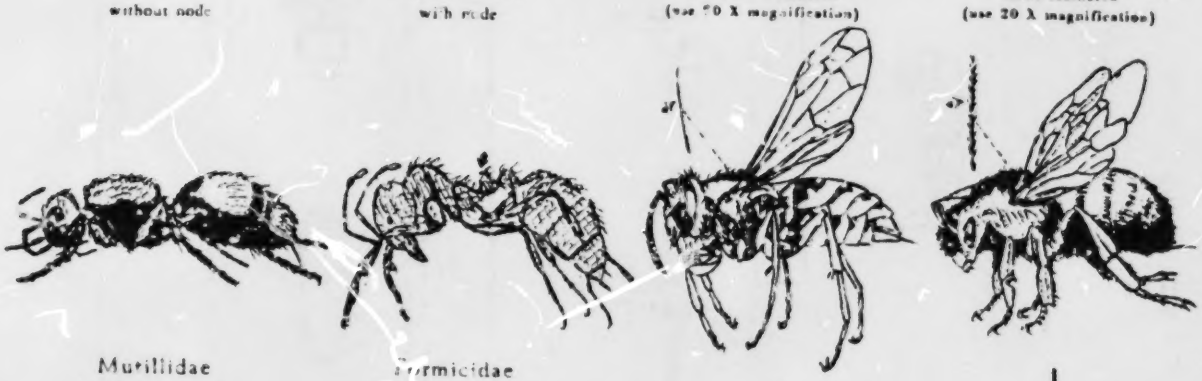
wings absent — wings present

body fur-like without node

body not fur-like with node

hairs not feathered (use 10 X magnification)

hairs feathered (use 20 X magnification)



Mutillidae
VELVET ANTS

Formicidae
ANTS

pronotum long, reaching tegula

pronotum short, not reaching tegula

Vespidae
WASPS, YELLOW JACKETS, HORNETS

Sphecidae
SPHECID WASPS

hind tibia with spurs

hind tibia without spurs

eye not reaching mandible

eye reaching mandible

Bombidae
BUMBLE BEES

Andrenidae
SWEAT BEES

Apidae
HONEY BEES

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center Training Branch, Atlanta, Georgia -- 1962

RODENTS

NATURAL HISTORY OF RATTUS

REPRODUCTION

Norway rats build their nests at ground level or in shallow burrows. Its close relative, the Roof Rat, builds nests in attics, trees and dense vegetation.

After mating, the young are born in 21 to 23 days in litters of 6-12 young. The young are able to eat solid foods by the time they are 3 weeks old, but continue to nurse for about 4 weeks. At four months, they reach reproductive maturity. In New Hampshire peak breeding is in the spring and fall. Reproductive rate of rats is high.

FEEDING

Most rats feed on any type of food but seem to favor certain types when available. Norway rats favor garbage and the Roof rat prefers cereals, nuts, fruits, vegetables, invertebrates and fish. Search for food usually begins shortly after sunset. When feeding, they prefer to drag food to enclosed areas where they are out of the exposed areas.

It is important to realize that rats are cautious feeders. When using a toxic bait, it is wise to pre-bait an area with non-toxic food at first. Toxicants may be added later in the control program.

SENSES

Rats have very poor eyesight, therefore, they must rely on smell, taste, touch and hearing to locate food and protect themselves from natural enemies.

Rats are considered to be colorblind and can distinguish only light from dark. The use of odorless and taste-free dyes for color coding baits does not interefere with the effectiveness of these baits.

A very important sensory factor is touch. Rats use their whiskers (vibrissae) and guard hairs on their bodies as tactile sensors. These help the rats travel in the dark, enabling them to locate food almost anywhere.

PHYSICAL CAPABILITIES (taken from Pest Control Magazine)

Rats can:

1. Gain entrance through any opening that is larger than ½ inch (1¼ cm) square;

2. Climb both horizontal and vertical wires;

3. Climb the inside of vertical pipes that are 1½ to 4 inches (4 to 10 cm) in diameter;

4. Climb the outside of vertical pipes of any size if the pipe is within 3 inches (7½ cm) of a wall or other continuous support for the rodent;

5. Climb the outside of vertical pipes and conduits up to 3 inches (7½ cm) in diameter;

6. Crawl horizontally on any type of pipe or conduit;

7. Jump vertically as much as 36 inches (1 meter) from a flat surface;

8. Jump horizontally 48 inches (1.2 meters) on a flat surface;

9. Jump horizontally at least 8 feet (2.4 meters) from an elevation of 15 feet (4½ meters);

10. Drop 50 feet (15 meters) without being killed or seriously injured;

11. Burrow vertically in earth to a depth of 4 feet (1¼ meters);

12. Climb brick or other rough exterior walls which offer footholds, to gain access to upper stories of structures;

13. Climb vines, shrubs, and trees, or travel along telephone or power lines to gain access to upper stories of buildings;

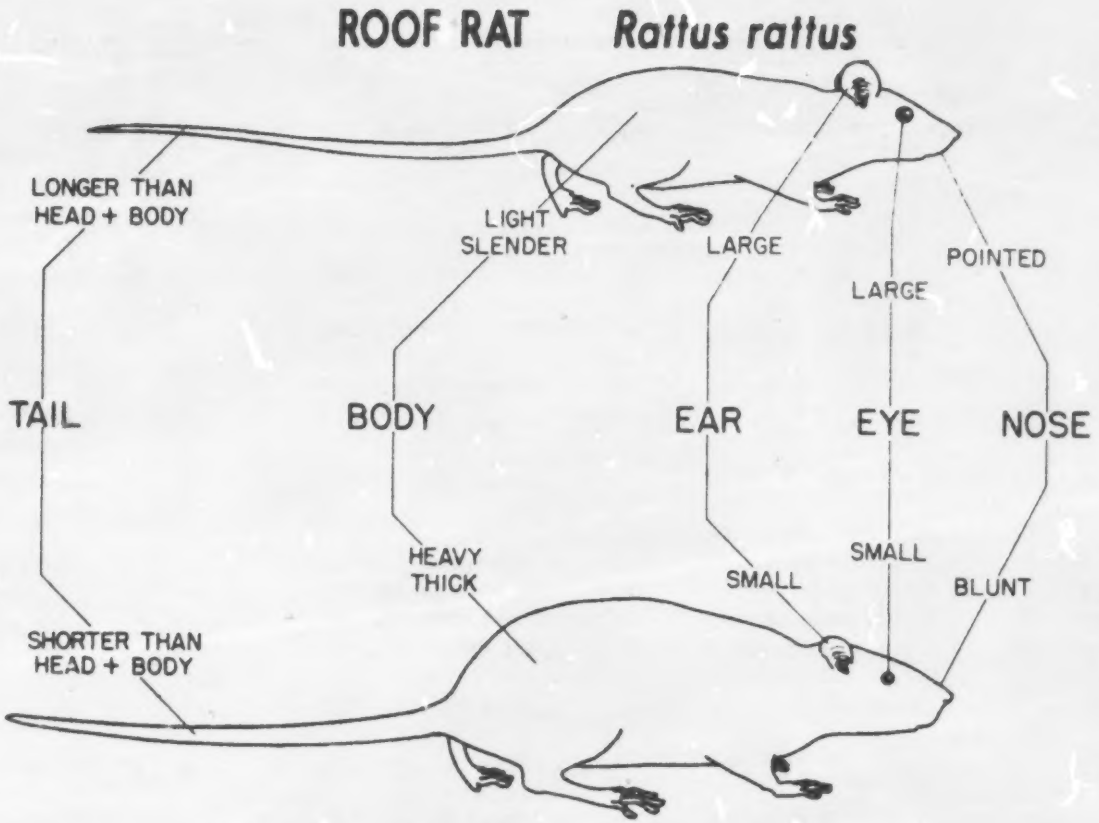
14. Reach as much as 13 inches (33 cm) along smooth vertical walls;

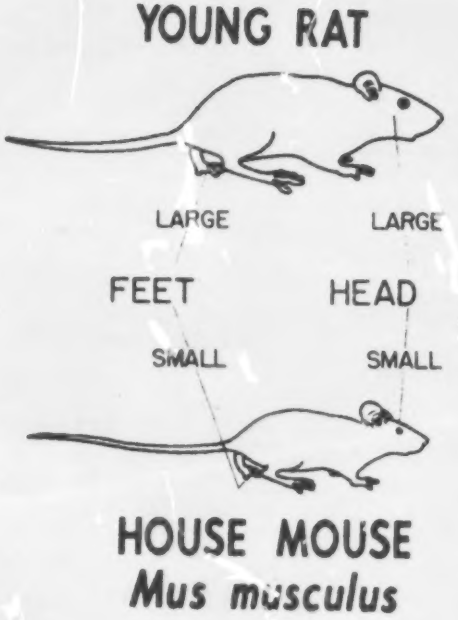
15. Swim as far as ½ mile (0.8 kilometer) in open water, dive through water plumbing traps, and travel in sewer lines even against substantial water currents;

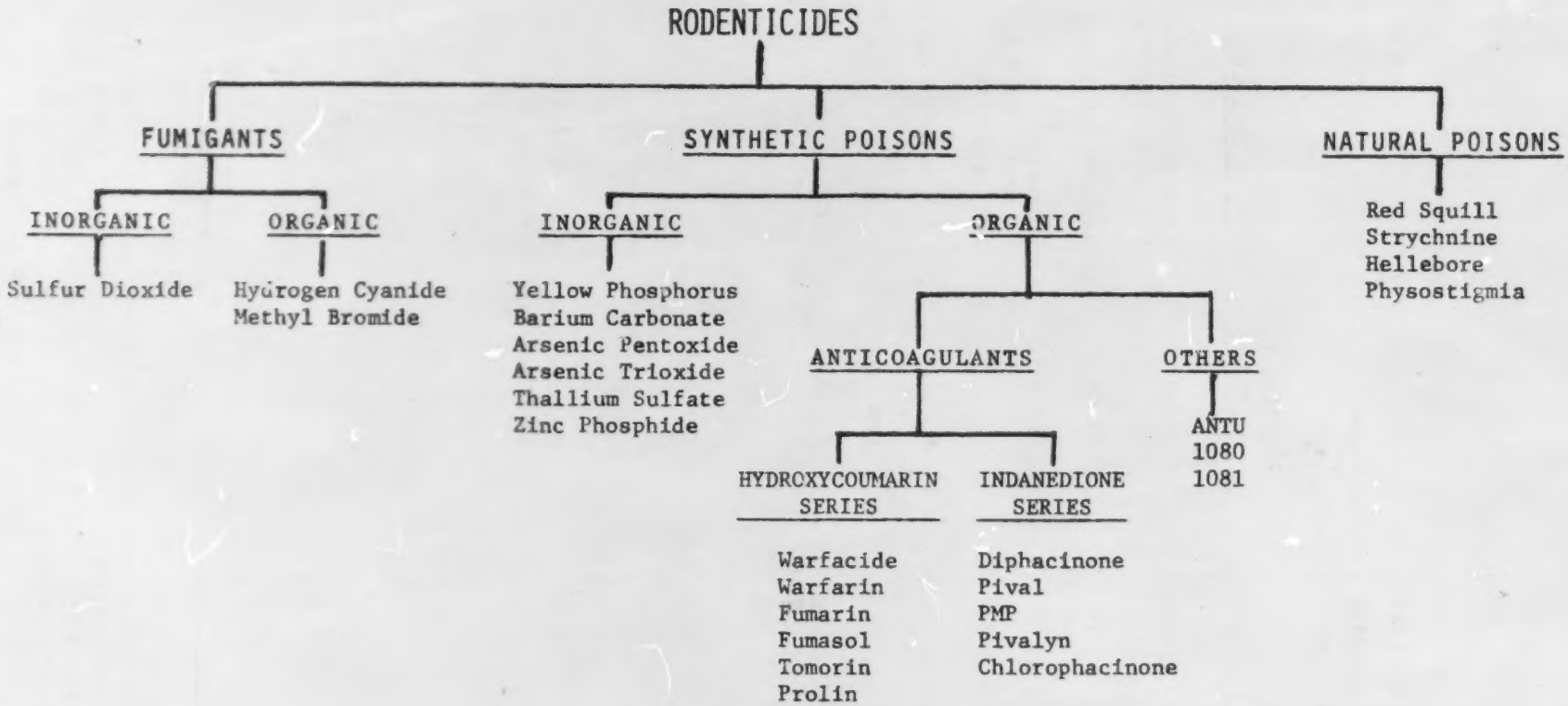
16. Gnaw through a wide variety of materials including lead sheeting, sun-dried abode brick, cinder block, and aluminum sheeting.

ADULT MURINE RODENT CHARACTERISTICS

CHARACTER	NORWAY RAT	ROOF RAT	HOUSE MOUSE
BODY	Large, husky	Medium slender	Small, slender
BODY WEIGHT	200-480 g (7-17 oz.)	110-300 g (4-10 oz.)	15-23 g (.5-1 oz.)
TOTAL WEIGHT	325-460 mm (12-18")	350-450 mm (14-18")	150-190 mm (6-7")
TAIL LENGTH	125-215 mm (5-8")	150-255 mm (6-10")	75-100 mm (3-4")
TAIL	Shorter than body, paler below, carried stiffly behind the animal, coarse scales	Longer than body at least reaching the snout, unicolor, moves about with whip-like motion	Equal to or a little longer than body-head length, paler below
HEAD	Muzzle blunt	Muzzle sharply pointed	Muzzle pointed
EARS	Close set, short, thick with short, fine hairs	Upright, thin, large hairless	Large with some hairs
EAR LENGTH	Rarely over 20 mm (3/4")	Over 20 mm (3/4")	Up to 15 mm (1/2")
HIND FOOT LENGTH	Over 40 mm (1.5")	Over 20 mm (3/4")	Under 20 mm (3/4")
NUMBER TEATS ON FEMALES	12	10-12	10
COLOR OF BELLY FUR	White with gray underfur	Uniform - all white, all buff or all gray	White to dark gray
OVERALL APPEARANCE	Coarse, brownish gray	Gray, black or brown	Fine brownish gray to gray
DROPPINGS	Up to 20 mm (3/4")	Up to 10 mm (1/3")	Up to 6 mm (1/4")


ROOF RAT Rattus rattus
LONGER THAN HEAD + BODY
LIGHT SLENDER
LARGE
POINTED
LARGE
TAIL
BODY
EAR
EYE
NOSE
HEAVY THICK
SMALL
SMALL
BLUNT
SHORTER THAN HEAD + BODY
NORWAY RAT Rattus norvegicus


YOUNG RAT
LARGE
LARGE
FEET
HEAD
SMALL
SMALL
HOUSE MOUSE
Mus musculus


RODENTICIDES
FUMIGANTS
INORGANIC
Sulfur Dioxide
ORGANIC
Hydrogen Cyanide
Methyl Bromide
SYNTHETIC POISONS
INORGANIC
Yellow Phosphorus
Barium Carbonate
Arsenic Pentoxide
Arsenic Trioxide
Thallium Sulfate
Zinc Phosphide
ORGANIC
ANTICOAGULANTS
HYDROXYCOUMARIN SERIES
Warfacide
Warfarin
Fumarin
Fumasol
Tomorin
Prolin
INDANEDIONE SERIES
Diphacinone
Pival
PMP
Pivalyn
Chlorophacinone
OTHERS
ANTU
1080
1081
NATURAL POISONS
Red Squill
Strychnine
Hellebore
Physostigmia

21

In order to counteract poisoning which may occur, P.C.O.'s must be aware of certain antidotes available. In the case of an emergency, the Poison Control Center for New Hampshire is at Mary Hitchcock Hospital, Hanover, N.H. (603) 643-4000.

POISON	%BAIT	HAZARD TO HUMANS	ANTIDOTE
Anticoagulants	0.025	Slight	Vitamin K and whole blood. Call a physician immediately.
Red Squill	10	Slight	Acts as its own emetic*
Zinc phosphide	1	Moderate	Copper sulfate before emetic: catharic and water; avoid fats and oils.
Arsenic trioxide	3	Moderate	Milk of magnesia, milk + water
ANTU	3	Moderate	NONE
1080	½ oz. per gallon	Extreme	None reliable (Monoacetin or ethyl alcohol and acetic acid recommended)
Thallium sulfate	0.7	Extreme	None reliable; sodium iodide and sodium thiosulfate recommended
Strychnine (alkaloid)	0.6	Moderate	No emetic after 10 minutes. Charcoal in water and sedative; Keep in dark room.
(sulfate)	0.8	Moderate	
Hydrogen cyanide		Extreme	Give oxygen and/or artificial respiration and amyl nitrate inhalation. Ferrous sulfate (158g) plus citric acid crystals (3g) dissolved in 1 litre of cold distilled water; Anhydrous sodium carbonate(60g) dissolved in 1 litre of distilled water. Seek medical help immediately; usually injection of cobalt edetate.

*Emetic. This is a substance used to induce vomiting. Readily available emetics include table salt, powdered mustard in water or milk. It is recommended that tartar emetic be added to baits where domestic animals are likely to feed upon the poisoned baits. This will help reduce the incidence of domestic animal poisoning.

Cooperative Extension Service
University of New Hampshire

Wildlife
Information
Series 1

BATS

Prepared by H. Stevan Logsdon, Extension Wildlife Specialist and Craig R. Fox

Cooperative Extension Service, University of New Hampshire, in cooperation with the Institute of Natural and Environmental Resources, Pettee Hall, Durham, N.H. 03824, Tel. (603) 862-1000

The two most common bat species in New Hampshire are the Little Brown Bat *(Myotis lucifugus)* and the Big Brown Bat *(Eptesicus fuscus fuscus)*. Six other species have been recorded: Say's Bat, Indiana Bat, Silver-haired Bat, Pipistrel, Red Bat and Hoary Bat. The Hoary Bat and the Indiana Bat are rare.

Two distinct groups of bats are found throughout New England, the solitary or tree bats and the cave bats. The Big and Little Brown Bats are both classified as cave bats. Tree bats choose to roost singly or in small clusters in woodlands while cave bats tend to frequent caves and buildings in colonies.

Cave bats are generally brown in color. An adult Little Brown Bat is dull brown on the back and yellowish brown underneath with a wingspan of about 10 inches. The Big Brown Bat has a wingspan of approximately 13 inches and is similar in color. Both are light in weight, usually less than three-fifths of an ounce.

Bats are of the order *Chiroptera*, the only mammals capable of true flight. Although references are made to the mouse-like qualities of bats, they are more closely related to an ancient shrew or mole-like animal. Some 50 million years ago this animal developed extra skin along the sides of its body, similar to that of flying squirrels. Gradually the skin became a thin, generally hairless membrane, stretching from the body and tail to the greatly-elongated finger bones of the forefeet.

The fingers, acting as wing supports, allow bats to catch flying insects and flee from ground-dwelling predators. Two hooked claws, one located on the leading edge of each wing, are used by the bat to maneuver itself into a roosting position and to crawl through openings in tight quarters. All New Hampshire bats have enlarged ears and sharp teeth. Both aid them in locating and seizing prey. Studies have shown that bats locate objects by using reflected sound waves. As the animal flies, it utters a series of rapid, high-pitched squeaks which are reflected by nearby objects, not unlike a sonar system. Quick reflexes and this system of echolocation allow bats to pursue and capture insects in darkness while avoiding collisions with objects. Although bats fly primarily with the use of sensitive ears, their eyes are still functional.

Bats hang head-down while roosting, firmly secured by hooking their toes into cracks or around small projections. From this position they drop from the roost by releasing their grasp while momentum from the fall helps them become airborne.

Habits

Bats are often seen flying during the early morning, late afternoon or evening hours, feeding on insects which they capture in an unusual way. By shaping one wing membrane into a momentary pouch, bats scoop up their prey, quickly seizing the insect before it can escape. This entire event occurs in less than a second, appearing as an erratic, faltering flight when several insects are captured in succession. Insects are eaten which are as large as moths, beetles and ichneumon wasps and as small as gnats.

When bats are not feeding, they seek shelter in dark, protected refuges where they are safe from predation or disturbance. Places such as rock crevices, hollow trees, caves and unoccupied buildings are commonly used. Here the colony sleeps to conserve energy until times of increased insect activity.

With the advent of fall and the declining availability of food, tree bats migrate south of New England or southeast to the Bahamas. Cave bats begin their hibernation by short colony migrations to local caves, some as far distant as

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Vermont. During the colder months when insects are not available, bats must live off fat stored in their bodies. To insure the slow use of this fat, bats lower their body temperatures to the air temperature of caves, usually in the low forties. At this temperature their heartbeat and breathing slow to the point where physiological activities almost stop. When temperature and humidity conditions change during hibernation, the colony awakens and moves to another roosting site. In the spring, when the first frost-free days occur, hibernation will end with the colony's movement to its former summer roost.

Bats mate in the late summer, fall or during arousal periods in hibernation, but embryonic development does not begin until late winter or early spring. The young are born between the months of May and July. Reproductive rates are low, normally one or two per litter. The young are born naked and helpless and are carried by the mother for several days until they become too heavy. Young bats remain in the roost until they become self-sufficient at about six weeks of age. The life-span of bats is long, counterbalancing their low reproductive rate. Normal life expectancy is from three to seven years. Banding studies have shown that the Little Brown Bat may live up to 24 years, but these are exceptional cases.

Health Problems

Disease in all animal populations acts to control their numbers to greater or lesser degrees. Rabies appears to act as a limiting factor of bat populations. However, two limiting factors with greater effect on the numbers of bats are the death of young bats from falling off the mother or from the roosting site and a low yearly reproductive rate.

The number of reported cases of rabies is few. There are usually no more than three or four cases a year reported to the New Hampshire Fish and Game Department. Contrary to popular belief, bats will rarely attempt to bite unless an attempt is made to capture or handle them. However, rabid bats are unpredictable. *Bats which may be observed to fly into objects, or are on the ground, should be avoided.* Children should be warned against attempting to capture or touch bats because they will bite to defend themselves as do other animals.

In case of a bat bite, the area of the bite should be washed immediately with hot, soapy water and a physician promptly notified. If possible, capture the bat without damaging the head, place it in a jar or plastic bag and keep it under refrigeration. Thick leather gloves or even several thicknesses of a bath towel should be used to prevent another bite. Health authorities will want the bat for a rabies test to determine if treatment of the person bitten is necessary.

Identification

The presence of bats in buildings is easily determined. The odor of urine and accumulation of bat droppings from roosting bats indicate their presence. Dark droppings about the size of a pencil lead and from three-sixteenths to one-quarter of an inch long, will be found surrounding entrances and roosting sites. Because bat droppings are dry and very crumbly they are easily distinguished from mouse droppings. An abundance of insect fragments can be observed with a hand lens. Squeaking and fluttering may be heard as bats enter and leave the roosting site for their feeding flights. The easiest way to determine the presence of bats is to stand outside during the last half-hour of daylight and observe their exit points from the building. Openings that are continually used will be stained brown from the bats' oily fur. These openings provide a place to begin observations.

Little Brown and Big Brown Bats are found to roost in attics, storage areas, vacant buildings, openings in building walls and occasionally under eaves. Roosting in buildings is generally limited to the warmer months of late spring, summer and early fall. On occasion, the Big Brown Bat may hibernate in buildings during the winter months because of its higher tolerance to cold temperatures. If temperatures fall below freezing for several consecutive days, they will seek a warmer place for hibernation. However, it is most common for bats to migrate in winter from unheated roosts to warmer caves.

Control Measures

When it is necessary to remove bats from buildings, the most practical method is bat-proofing. All entrances and exits used by the bats should be closed and sealed. Entrances into buildings may include loose vents, broken windows, cracks in old siding, flashing around chimneys and openings under eaves. Smaller bat species have been known to crawl through openings three-eighths of an inch in width. For this reason, it is important to check for openings that may seem insignificant. Some sources report that bats can find openings in an attic by sensing air currents.

All bats should be out of the building before bat-proofing is completed. The roost normally becomes unoccupied 15 to 20 minutes after the first bat leaves the building. Bat colonies migrate from unheated buildings during the late fall (October-November) and reappear during the early spring (March-April). During this period, bat-proofing may be completed without the difficulties of colony removal. Bat-proofing should be restricted in May, June and July because young bats, not yet capable of flight, may occupy the roost.

Bright lights used to illuminate the roost may act as a repellent. This technique can be employed to remove bats while bat-proofing is completed. The smell of moth blocks will also act as a repellent. In cases where these repellents are used, bats will evacuate buildings even during daylight hours. Due to their rapid dissipation on contact with air,

repellents should not take the place of bat-proofing. Proofing is the only measure that will effectively prevent the establishment of new colonies.

The use of poisonous baits is impractical because bats feed primarily on flying insects. The use of poisons, gases and chemical controls by homeowners is illegal. Professional fumigation is not suggested due to problems of cost and odor from decomposing bats killed between walls. New colonies will become established if bat-proofing measures are not taken.

To close off entrances, re-nail boards and flashing. Larger entrances may be covered with sheet metal or boards. If ventilation is necessary, cover openings with one-quarter-inch mesh hardware cloth. Close cracks by packing them with steel wool or other packing material. Cover with caulking compound and paint. Also check points at which electrical wires enter.

Although most bats are unprotected by law, they should not be needlessly disturbed or destroyed. The Indiana Bat is protected under the 1973 Endangered Species Act.

The following bat control steps are suggested:

1. Observe and identify all entrances and exits.
2. Close all openings greater than one-quarter of an inch, leaving one entrance or exit open if several are used. Allow two or three days for bats to adjust to this opening. An open window or vent may be preferred.
3. Close the remaining openings after the colony leaves on its evening or early morning feeding flight.
4. Observe the building (eaves, chimneys and vents) for several evenings. If entrances were overlooked and bats are still present, the process should be repeated.
5. When the roost is cleaned to remove odors, a respirator should be used. Odors of bat urine and droppings will attract new colonies. Napthalene flakes will mask odors where there are large accumulations of droppings.

Environmental Importance

Bats occupy a special place where competition with other animals for food and shelter is minimal. They are considered beneficial because of the large quantities of insects consumed at each feeding. Some persons even allow bats to roost in unused buildings because of their insect diet. Others simply enjoy their presence on camping or fishing trips as part of the evening's scene.

We would like to acknowledge the assistance of Rene Bollengier and John Davis of the New Hampshire Fish and Game Department in the preparation of this pamphlet.

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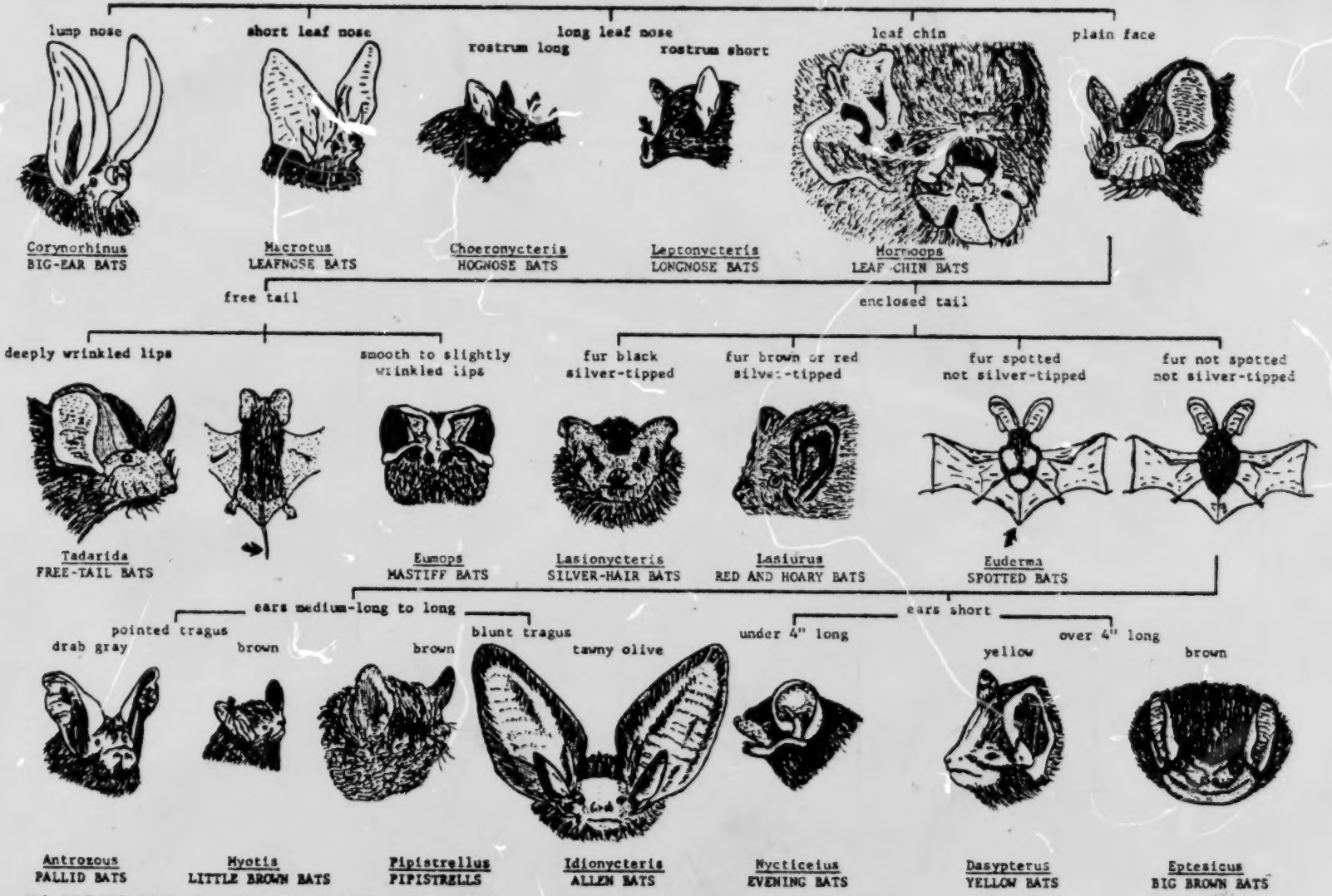
U.S. Fish and Wildlife Service, 55 Pleasant Street, Concord, N.H. 03301. Tel. (603) 225-9621.

BATS: PICTORIAL KEY TO UNITED STATES GENERA

Harold George Scott and Chester J. Stajanovich



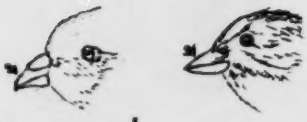
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1960 – Revised 1962

BIRDS: PICTORIAL KEY TO SOME COMMON PEST SPECIES OF PUBLIC HEALTH IMPORTANCE

Margaret A. Parsons and Chester J. Stojanovich

bill short

bill long



male and female, body plump, tail fan-like

body trim, tail not fan-like

COMMON PIGEON

male, body black, head brown
female, overall dull grey color

male, black throat, grey crown
female, whitish throat, dull eye stripe

male

female

COMMON COWBIRD

female

male

HOUSE SPARROW

male, wing with red 'epaulettes'
female, breast heavily striped, light eye stripe

wing without 'epaulettes'
breast not heavily striped

female

male

RED-WINGED BLACKBIRD

males, plain bronze or
dull purple back, tail long
females: less iridescent, smaller size

winter, bill dark, body heavily speckled with light dots
spring, bill yellow, color purple and green

male and female,
very large size, coal
black color, tail flat

winter phase

summer phase

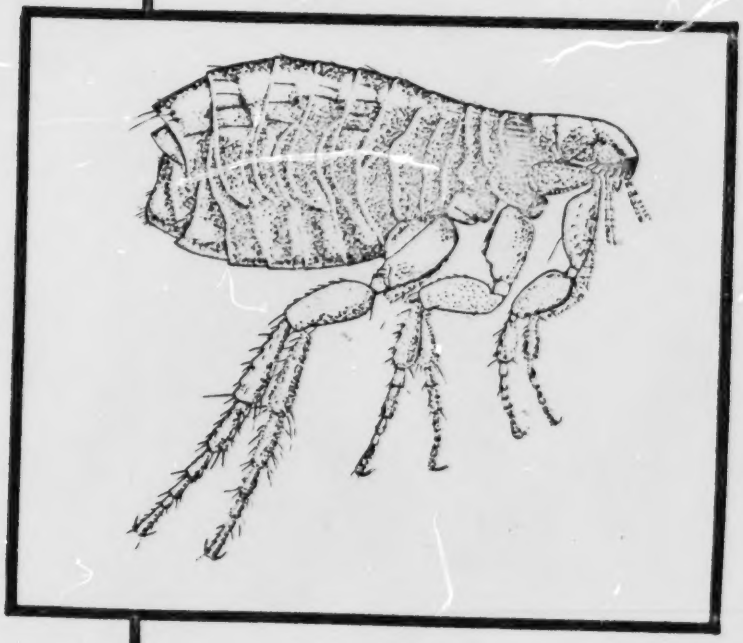
GRACKLES

STARLING

CROWS

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1964

CONTROLLING FLEAS



HOME AND GARDEN BULLETIN NO. 121
U. S. DEPARTMENT OF AGRICULTURE

CONTROLLING FLEAS

Fleas often breed in large numbers where pets and livestock are kept. They spread through homes, buildings, and yards. They attack pets, livestock, poultry, and people.

Pets infested with fleas scratch and bite themselves almost constantly. Their coats become soiled and roughened, and their skin becomes irritated.

Domestic animals are painfully annoyed by fleas, and young chickens and other poultry are sometimes killed by heavy infestations.

You can control fleas by applying proper insecticides.

COMMON KINDS

Many kinds of fleas attack animals and people.

The dog flea [1] and the cat flea [2] are the most widespread and abundant. Each kind attacks dogs and cats.

The human flea,[3] a severe pest in many areas, lives on numerous animals. It is often found on hogs, and it breeds in hog houses. It also lives on dogs, cats, goats, and domestic rats and on wild animals such as skunks, coyotes, and badgers. It most often is found in the Mississippi Valley, in Texas, and westward to the Pacific coast.

The sticktight flea [4] infests poultry and occasionally annoys people and pets in the Southern States.

Several species of rat fleas, particularly the oriental rat flea,[5] infest houses and buildings that harbor rats.

All of these fleas can bite people.

DEVELOPMENT

Fleas pass through four stages of development—egg, larva (maggot), pupa, and adult.

The female adult lays eggs on an animal or in its sleeping place. The eggs fall off the animal and, within a few days, hatch into larvae.

The larvae are fully grown in about 2 weeks; then they spin tiny cocoons in which they change into pupae.

The pupae change into adults in about 1 week and emerge from the cocoons.

Adult fleas can live several weeks without food. This is why owners of dogs or cats sometimes return

[1] *Ctenocephalides canis.*
[2] *C. felis.*
[3] *Pulex irritans.*
[4] *Echidnophaga gallinacea.*
[5] *Xenopsylla cheopis.*

SAND FLEAS

Although fleas found in sandy places often are called "sand fleas" there is no flea by this name. Many kinds of fleas develop in sandy places—as a result of being dropped there (as eggs or adults) by flea-infested animals.

from vacation to find their homes overrun with fleas, even though no adult fleas were in evidence when they left for vacation.

Fleas feed on animal or human blood; they cannot breed or survive without it.

CONTROL WITH INSECTICIDES

The kind and amount of insecticide needed to kill fleas depend on (1) the kind of animal that is infested and (2) whether an infestation is inside or outside a home. Insecticides used in the home differ from those used in other locations.

Control of fleas on animals is necessary to prevent infestations in homes, animal quarters, and yards.

Fleas on Animals

Dogs and Cats

Malathion, methoxychlor, rotenone, or pyrethrum (pyrethrins) will kill fleas on dogs and cats. You can buy these insecticides ready for use as flea powders or sprays.

Powders.—Use a powder that contains no more than: 5 percent of malathion, 5 percent of methoxychlor, 1 percent of rotenone, or 1 percent of pyrethrins. Flea powders sold for dogs and cats often contain several of these insecticides combined—each at a lower concentration than those listed above.

Sprays.—Use a spray that has not more than 0.5 percent of malathion or methoxychlor.

Use insecticides carefully. Follow directions on the container. Don't be alarmed if your dog or cat shows discomfort for a few minutes after the application. Insecticides often cause increased activity by the fleas in their last moments of life. If the animal has free run, treatments may have to be repeated to keep fleas under control. (Treat the animals only as often as suggested on the container label.) If the animal is confined to an area free of fleas, one treatment usually is enough.

Fleas begin to leave the animal within a few minutes after a pyre-

N-14410

Applying powder for control of fleas.

N-14411

Rubbing powder into dog's hair.

thrum powder is applied, but they are only paralyzed and may recover. Treat the animal outdoors or in an enclosure where the paralyzed fleas can be swept up and destroyed.

Chickens

Sticktight fleas may be a problem on chickens. Spray infested chickens with a 0.5-percent malathion spray (see chart) or treat them with 5-percent malathion dust.

Fleas in Animal Quarters and Yards

To destroy fleas in dairy barns and poultry houses, use malathion. In other barns and animal quarters, in yards and lawns, and under houses, spray or dust with the insecticides recommended under "Fleas on Animals" or apply a 1-percent ronnel spray (see chart). If animal quarters or pens are littered, remove the litter before spraying or dusting.

Spraying.—Apply spray at the rate of 2 gallons to 1,000 square feet (but apply 1 gallon of 1-percent ronnel). Use a garden-type compressed-air sprayer or small power sprayer.

Dusting.—Apply malathion dust at the rate of 1 pound per 40 square feet in poultry quarters. Apply 1 to 2 pounds per 1,000 square feet in dog kennels or goat or hog quarters.

Apply methoxychlor dust at 1 pound per 1,000 square feet, but only in dogs, goat (except milk goat), and hog quarters. Dusts often can be blown under low buildings where spraying would be difficult.

Fleas in Homes

Sprays that contain methoxychlor, malathion, or ronnel will destroy fleas in homes.

Apply a 5-percent methoxychlor spray or 2-percent malathion spray to floors and baseboards and to walls to a height of about 1 foot. Apply a light mist to upholstering, rugs, and other fabrics; a heavy spray may stain fabrics. Before spraying, clean rooms and up-

N-14414

Dusting under doghouse for control of fleas.

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GUIDE FOR MIXING SPRAYS

Insecticides and some of the forms in which they may be purchased	Percentage of insecticide desired in spray	Approximate amount of purchased product to mix with 5 gallons of water
METHOXYCHLOR		
50-percent wettable powder	0.5	6 ounces.
25-percent emulsifiable concentrate	.5	1 pint.
MALATHION		
25-percent wettable powder	.5	12 ounces.
57-percent emulsifiable concentrate	.5	6 ounces.
RONNEL		
24-percent emulsifiable concentrate	1.0	1⅓ pints.

holstered furniture with a vacuum cleaner.

To prepare sprays for use in homes: Mix 6¼ tablespoons of 25-percent methoxychlor emulsifiable concentrate, or 3¾ teaspoons of 50 to 55-percent malathion emulsifiable concentrate in 1 pint of water.

If you apply a ronnel spray, see that it is labeled for home use and follow instructions on the label.

PRECAUTIONS

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers—out of reach of children and pets—and away from foodstuff.

Apply pesticides selectively and carefully. Do not apply a pesticide when there is danger of drift to other areas. Avoid prolonged inhalation of a pesticide spray or dust. When applying a pesticide it is advisable that you be fully clothed.

Do not apply methoxychlor, ronnel, or rotenone in dairy barns or poultry houses.

After handling a pesticide, do not eat, drink or smoke until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If the pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Dispose of empty pesticide containers by wrapping them in several layers of newspaper and placing them in your trash can.

It is difficult to remove all traces of a herbicide (weed killer) from equipment. Therefore, to prevent injury to desirable plants do not use the same equipment for insecticides and fungicides that you use for a herbicide.

This edition replaces all previous editions of this publication. Because of changed insecticide recommendations, earlier copies should be destroyed.

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Southern Region
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Washington, D.C.
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For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 25 cents

* GPO : 1971 O - 370-445

6

the HOUSE FLY

how
to control
it

Leaflet No. 390
U. S. DEPARTMENT OF AGRICULTURE

THE HOUSE FLY

how to control it

The house fly [1] is a danger to the health of man and animals principally because it carries and spreads disease germs that may be in the materials it breeds in, feeds on, or walks on.

This fly feeds and breeds most extensively in manure, garbage, and fermenting crop wastes. If disease germs are in these materials, or in others that they frequent, the flies get them on their hairy legs and feet and in their digestive tracts. If the flies have access to man's food, they contaminate it by walking over it.

By contaminating food and water and by coming in direct contact with the hands and mouth, the flies spread typhoid, dysentery, and diarrhea. They have a part in spreading cholera, yaws, trachoma, and many other diseases.

To control the house fly in and around the home and on the farm, do these things:

Eliminate breeding places of flies.

Follow sanitary practices constantly. Keep garbage and other refuse under cover; dispose of garbage frequently. On the farm, dispose of manure properly.

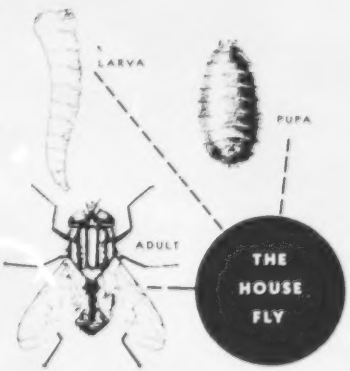
Screen windows and doors of the home and of dairy barns and milk rooms.

Kill flies. Use space and surface sprays in and around the home. Use space sprays, surface sprays, and insecticide baits in and around farm buildings. (Electric grids and traps are effective fly-killing devices in some circumstances.)

Some house flies have developed a resistance to certain insecticides. Although flies can usually be controlled with malathion, crotoxyphos, or ronnel, as recommended, resistance to these insecticides may occur in some areas.

SANITATION

Despite advances in the development of insecticides, sanitation continues to be the mainstay of house fly control in and around the home and on the farm.



[1] *Musca domestica L.*

Flies breed in places where garbage or filth accumulates. Find and eliminate such places. Clean up. Bury or otherwise dispose of dog, cat, and chicken excreta around the yard.

Make sure you have tight-fitting lids on garbage cans.

Do not let garbage accumulate in the open. Do not let it stand until it ferments; insist on frequent pickups.

SCREENS

Well-fitting screens on windows and doors are essential for keeping flies out of homes, dairy barns, and milk rooms.

In a humid climate, use screens of copper, aluminum, bronze, plastic, or one of the rust-resisting alloys.

Screens with 14 meshes to the inch will keep out house flies, but 16-mesh screens will keep out some other insects also.

INSECTICIDES

To kill flies quickly inside the home, use an insecticide in a space spray (or in an aerosol). *Outside the house*, apply a surface, or residual, spray to garbage cans, screens, porches, door and window frames, edges of arches, and other places where flies gather, or use an insecticide bait. Do not contaminate food, water, or utensils.

To kill flies in and around farm buildings, apply a surface spray to the inside and outside of stables, dairy barns, hog houses, poultry houses, and other buildings in which livestock are kept. A space spray may also be used. (See precautions on page 8.) Do not contaminate feed, water, milk, or milking utensils.

Space Sprays

Several kinds of ready-to-use space sprays for killing flies inside the home and barn may be purchased. Buy the best-grade sprays from a reputable dealer.

Look for space sprays of the following types:

- Those that contain 0.1- to 0.25-percent pyrethrins plus 1 to 2 percent of a synergist. (The synergist increases the effectiveness of the pyrethrins.) Do not use pyrethrins in dairy barns or poultry houses. (See precautions for barn use on page 8.)
- Aerosol bombs provided the labels say that the contents are for use against flying insects.
- Space sprays and aerosols that contain 2-percent malathion or 0.5-percent ronnel. Do not use the sprays in barns.

To kill flies in a room, release a mist from a hand or power sprayer or from an aerosol bomb for a few seconds, and keep the room closed for an hour.

Surface Sprays

Surface sprays leave a residue that may be effective for several weeks.

Malathion, crotoxyphos, dime-

thoate, and ronnel are recommended for use as surface sprays in barns, but be sure to observe the precautions for barn sprays on page 8. Malathion and ronnel may be used as surface sprays in homes. Apply them around windows and to other areas frequented by flies. Apply insecticides at the rate of 1 or 2 gallons per 1,000 square feet. Moisten the surface without causing runoff.

In treating farm buildings, use a power, compressed-air, or knapsack sprayer.

Crotoxyphos

Apply as a 1-percent emulsion spray. Mix 10 tablespoons of 25-percent emulsifiable concentrate in 1 gallon of water to make the proper concentration of insecticide.[2]

Do not use crotoxyphos in poultry houses.

Dimethoate

Apply as a 1-percent emulsion spray. Mix 10 tablespoons of 25-percent emulsifiable concentrate in 1 gallon of water to make the proper concentration of insecticide. Remove animals from buildings before using dimethoate. Do not treat milk processing rooms.

Malathion and Ronnel

Apply as a 2½-percent malathion or a 1-percent ronnel spray. Mix 25 tablespoons of 25-percent malathion or 10 tablespoons of 25-percent ronnel emulsifiable concentrate in 1 gallon of water. Do not use ronnel in dairy barns or poultry houses.

[2] If the product you buy contains a lower or higher percentage of the insecticide, use proportionately more or less of it.

INSECTICIDE BAITS

Insecticide baits control house flies in some places where sprays fail, particularly in unscreened dairy barns and in poultry houses. If properly applied, they can be used in most farm buildings without harming domestic animals. The baits described here are not approved for use in the home, milk rooms, and restaurants.

The effective insecticides are malthion, ronnel, dichlorvos, and naled. Ready-to-use dry baits containing most of these insecticides are on the market. Trichlorfon is available as a ready-to-use bait.

Making A Bait

Try to buy a ready-to-use bait. If it is not available, buy an emulsifiable concentrate of one of the approved insecticides and make a bait.

Liquid Bait

Make a liquid bait by mixing an arrestant—molasses, sirup, or sugar—and one of the insecticides with water. Mix 12 ounces of an arrestant in 1 gallon of water. The amounts of insecticide to add to the water-arrestant solution are given in this tabulation:

Insecticide	Emulsifiable concentrate (percent)	Tablespoons
Malathion	25	12.5
Ronnel	25	20
Dichlorvos	25	2
Naled	58	3

Dry Bait

A dry bait can be made by mixing a wettable powder of an insecticide in granulated sugar. Add about ¼ teaspoon of lampblack per pound of sugar. Stir with a paddle until all the grains of sugar are coated with powder and colored a dirty gray. This prevents mistaking the bait for ordinary sugar. The amounts of wettable powder to mix with 1 pound of sugar are given in the following guide.

GUIDE FOR MIXING A DRY BAIT

Insecticide	Wettable Powder (percent)	Tablespoons
Malathion	25	4
Ronnel	25	1

Cornmeal Bait

A cornmeal bait is recommended for use on moist surfaces, where a dry sugar bait would dissolve.

While stirring 1 pound of coarsely ground cornmeal, slowly add the following:

- 1 tablespoon of peanut oil.
- Wettable powder of malathion, or ronnel. (For proper amount, see "Guide for Mixing A Dry Bait.")
- 2 ounces of powdered sugar.
- ¼ teaspoon of lampblack.

Stir with a paddle until all the meal particles are coated with the sugar and the wettable powder. Stirring for 5 minutes insures proper mixing of quantities of 1 to 5 pounds. Mixing of larger quantities by hand is not recommended.

Applying the Bait

Frequency

When flies are numerous, spread bait daily. When fewer flies are seen spread bait once every 3 or 4 days. If flies again become numerous, apply more frequently.

How and Where

Place baits where you find flies gathering. The arrestant will make the flies stop and feed; it is not a true chemical attractant.

If you buy a *ready-to-use dry bait*, apply it according to the directions on the container .

Apply *homemade liquid bait* with an ordinary sprinkling can. Plug about half the holes so that the bait will spread thinly in strips 4 to 6 inches wide on floors. If the floors are covered with dirt or litter, sprinkle the bait on sheets of tin, wood, or paper.

Apply at the rate of 1 gallon to 1,000 square feet.

Apply *homemade, dry sugar bait* with a shaker-top can. Sprinkle thinly in narrow strips on floors, walkways, window sills, and other places where flies

gather, but not where it will contaminate animal feed, water, human food, or utensils. Use it only on dry, firm surfaces.

Apply at the rate of 3 tablespoons per 1,000 square feet—or about ¼ pound for an average-size barn (one with 2,000 to 4,000 square feet of floor).

Apply *cornmeal bait* at the rate of 2 to 4 ounces per 1,000 square feet in barns or sheds. A higher rate—4 to 8 ounces per 1,000 square feet—may be necessary in open places; the rate depends on the condition of the surface and on the abundance of flies.

PAINT-ON BAIT

Neither a dry bait nor a liquid bait gives good control of flies in animal pens in which the ground is trampled, littered, or muddy.

A paint-on bait usually gives good control in these places. It is applied with a paintbrush to suitable surfaces nearby, such as posts, railings, or board fences. Corn sirup, blackstrap molasses, or a thick water-and-sugar slurry containing 1.25 percent of malathion, 2.0 percent of ronnel, 0.1 percent of dichlorvos or 0.5 percent naled makes a satisfactory paint-on bait. The amounts of insecticide to mix in 1 gallon of arrestant are listed below.

Insecticide	Emulsifiable concentrate (percent)	Tablespoons
Malathion	25	12.5
Ronnel	25	20
Dichlorvos	25	2
Naled	58	3

Apply the bait whenever flies become numerous. Paint or daub it on. One application is effective about a week.

If you apply bait to a fence around a pen, apply it only to the outside.

A fence around an average-size calf pen or pigpen can be adequately treated with 2 quarts of bait.

MANURE DISPOSAL

House fly control on the farm requires proper management of livestock, and poultry wastes.

To discourage fly reproduction, manure should be removed daily from stables, dairy barns, pig-feeding lots, and poultry houses, and spread thinly on fields.

If it is necessary to store the manure for short periods, screened storage pits or bins should be used. Composting is an alternative holding technique. However, if the manure is composted, it must be turned periodically to stop maggot growth.

Slatted floors are placed over collection pits in animal shelters

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Mention of a proprietary product in this publication does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture and does not imply its approval by the Department to the exclusion of other products that may also be suitable.

The insecticides mentioned in the text may not be commercially available by their common names, but may be purchased under the following comercial designations:

Common Name	Other Designations
Crotoxyphos	Ciodrin, Shell SD-4294
Malathion	Cythion, Carbophos
Dimethoate	Cygon, Rogor
Ronnel	Korlan, Trolene, Dow ET–14
Trichlorfon	Dipterex, Dylox, Neguvon
Dichlorvos	DDVP, Vapona, Nuvan
Naled	Dibrom
Pyrethrins	Pyrocide

to reduce fly reproduction. Some large livestock operations flush animal wastes from buildings with water and spread the slurry on fields with a tank-type spreader or an irrigation system.

If a waste disposal lagoon is used, its banks should be sloped to prevent propagation of flies and accumulation of wastes.

GRIDS AND TRAPS

Electric grids mounted in the open, or attached to window and door screens, kill many flies, but do not control satisfactorily.

An electric grid consists of parallel wires, about one-quarter inch apart, connected to a high-voltage, low-amperage circuit. Insects that try to pass between any two wires are electrocuted.

Flies can be attracted to the grid with ultraviolet fluorescent lamps (type BL or BLB) or with bait. A good bait consists of the following: 8 ounces of cornmeal, 5 ounces of molasses, 1 cup of water, and a ½ cake of yeast.

Several kinds of electric grid traps are used in places where flies gather. Among them are traps equipped with ultraviolet lamps, homemade or commercial screen traps, and jar traps.

GARBAGE DUMPS AND PACKING PLANTS

House flies that breed in municipal garbage dumps can be controlled by applying one of the insecticide baits discussed in this leaflet. Apply either a liquid or a dry bait. Apply liquid bait at the rate of 5 to 10 gallons per acre. Apply dry bait at the rate of 5 to 10 pounds per acre.

Flies that breed in wastes around vegetable- and fruit-packing plants can be controlled by spreading baits, spraying waste material with insecticide, applying surface sprays outside the plant where flies gather, and applying surface sprays and space sprays inside the plant before the packing season begins. Space sprays may be used during the packing season, but only during hours when the plant is not in operation. Spraying waste ma-

terial with insecticide may be hazardous to birds and other wildlife.

PRECAUTIONS

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers—out of the reach of children and pets—and away from foodstuff.

Apply pesticides selectively and carefully. Do not apply a pesticide when there is danger of drift to other areas. Avoid prolonged inhalation of a pesticide spray or dust.

After handling a pesticide, do not eat, drink, or smoke until you have washed. In case a pesticide is swallowed or gets in the eyes, follow first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Dispose of empty pesticide containers by wrapping them in several layers of newspapers and placing them in your trash can.

Barn sprays.—Do not use pyrethrins or ronnel in poultry houses or dairy barns. Remove animals from dairy barns before using sprays other than crotoxyphos. Remove poultry from houses before spraying with dimethoate.

Home sprays.—Use only products specifically labeled for use in homes.

NOTE: Registrations of pesticides are under constant review by the U.S. Environmental Protection Agency. Use only pesticides that bear a Federal registration number and carry directions for home and garden use.

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Southern Region
Agricultural Research Service

Washington, D.C. Revised November 1975

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